EXTENDED TESTIMONY OF OLIVER J. MURPHY, PRESIDENT, LYNNTECH, INC.

For: Subcommittee on Basic Research, Committee on Science, U.S. House of Representatives

Subcommittee Chairman: Nick Smith

Hearing Title: Tools for Enhancing Small Business Competiveness in the Dallas Area: A Review of Federal Programs

Date: January 23, 2003

INTRODUCTION

Mr. Chairman, Congresswoman Johnson, members of the subcommittee, I thank you for allowing me the opportunity to testify before you regarding the Small Business Innovation Research (SBIR) Program, the related Small Business Technology Transfer (STTR) Program, and the opportunities that these programs offer to small businesses in the United States, and in particular in the State of Texas.

My name is Oliver J. Murphy, cofounder and President of Lynntech, Inc., a small business specializing in the development and commercialization of new technologies. Lynntech is located in College Station, the home of Texas A&M University. I have actively participated in research and development work, as well as technology development and commercialization efforts, for over twenty years, first in academia, second in a large corporation, and finally in a small business. Having experienced all three working environments, I am convinced that employee satisfaction, growth, creativity, and productivity are greatest in small businesses. Small businesses are good for the United States because they create a growing number of jobs each year in this country and develop an increasing amount of new technologies as evidenced by the number of U.S. patents attributed to this business sector. In order to maintain economic growth and to enhance our standard of living in this country through the decades to come, as a society we must devote the necessary resources to foster the growth of existing small high technology businesses and to create new small businesses at a faster pace. A significant amount of these resources can be made available to those small businesses through the SBIR and STTR programs. Improved and enhanced variants of these programs are essential for the creation and growth of a major segment of small high technology based businesses in this country.

Since, to a large extent, venture capitalists no longer make seed round investments in start-up technology based ventures, increasingly small businesses face the challenge of securing the needed capital to demonstrate the technical and commercial feasibility of their concepts or ideas. Over the last decade venture capitalists have made only later stage investments in small technology based companies after the technical and commercial risks have been minimized or almost eliminated. In many cases this has led the principals of new, start-up technology development ventures to raise seed capital from family and friends, which in most cases is

insufficient to reach desired milestones and leads to the failure of many such ventures. The unique and essential aspect of the SBIR and STTR programs is that they provide to for-profit small businesses the difficult to obtain early stage financial support necessary to develop high-risk, high-payoff technologies. Solicitations for proposals, issued at least annually, by participating Federal Government Departments and Agencies encompass the complete spectrum of technologies from aerospace to biotechnology and nanotechnology. This eliminates any technology bias or so-called "picking winners" by the Federal Government.

With the continued downsizing of most large industrial corporations and increasing pressure on management teams to meet or exceed the next quarterly earnings expectations, long range research and technology development efforts within many of these corporations have been reduced significantly over the past ten to fifteen years. To maintain a technological and competitive edge to their products in what is rapidly becoming a global economy, large companies need to have access to the latest developed technologies. It has been recognized more and more each year that a ready source of proven high technologies for these large companies exists within many SBIR and STTR funded small businesses throughout the country. Through either acquisitions, strategic relationships, or licensing arrangements, commercialization of many of these developed technologies is accomplished by large corporations.

Alternatively, commercialization is achieved by the small businesses themselves by raising additional capital in the public markets and/or as the result of venture capital investments, such investments and raising of capital being made after the initial SBIR funding has been spent. Because of the growing trend of a short term business focus and the increasing tendency to avoid technology risk within large industrial organizations in this country, the need for small, high technology businesses and their ability to obtain technology development funding from State and Federal Government entities, such as that made available through the SBIR and STTR programs at present, will be essential for the generation of jobs in the future and the creation of wealth and prosperity in this State and the other States.

The existing SBIR and STTR programs are models for funding technology development and commercialization within small businesses that can be improved, enhanced, and expanded upon so as to stimulate regional or local economic development and give greater returns to the taxpayer. To illustrate the opportunities offered by the SBIR and STTR programs, I will outline below the experiences of Lynntech with these programs.

LYNNTECH'S EXPERIENCE WITH THE SBIR AND STTR PROGRAMS

Lynntech was founded as a small, high technology business in 1987 and incorporated as a Texas Corporation. At the time of organizing the company, the founders were employees of Texas A&M University. However, the company did not initiate full time business activities until January of 1990, after its two initial employees resigned their positions at Texas A&M in December 1989. Since that time the business activities of the company have focused on the development and commercialization of new technologies in four primary areas: (i) environmental technologies; (ii) electrochemical energy conversion and storage; (iii) corrosion and materials science; and, (iv) biomedical/bioengineering. Early stage development of technologies in these key areas has been supported by funds received from the Federal

Government through the Small Business Innovation Research (SBIR) Program. After the technical feasibility of various technologies have been established, the company has been successful in obtaining advanced technology development funding through other Federal Government programs such as, Broad Agency Announcements (BAAs), Program Research and Development Announcements (PRDAs), and other Agency solicitations. Subsequently, in a number of cases, advanced hardware developments that yielded prototype devices were created as a result of establishing relationships with intermediate-size and large-size industrial corporations. These have resulted in successful commercial products and processes. The goal of the company from the day it was founded is to commercialize products and services derived from successfully developed new technologies. The company's commercialization plan includes licensing arrangements, spinoffs, joint ventures, and outright sale of developed technologies where appropriate. A number of these commercialization mechanisms have been successfully exploited by Lynntech and involved technologies developed with SBIR funding.

Critical to the success of Lynntech in developing and commercializing new technologies has been its participation in and support by the SBIR programs of almost all of the Federal Government Departments and Agencies. The company has received SBIR Phase I, Phase II, and Phase III awards from Departments and Agencies that issue contracts, and from those that award grants. This has allowed the company to maintain a sustained technology development effort for a number of technologies, such as fuel cells, that are recognized to be of vital importance to national security and to the country's economic future. Fuel cell power sources have multiple applications for which large markets are a few years to over a decade away. After learning how to work with the various Government Departments and Agencies over the first few years of being in business, the SBIR experience from proposal submission, contract negotiation, contract or grant administration, and reporting have been very good. A marked improvement has occurred over the years with regard to receiving payments from various Agencies under the SBIR program, in particular, for contracts having progress payments.

A measure of success in developing new technologies within Lynntech under the SBIR program is to record the number of issued U.S. patents assigned to the company. To date Lynntech has received 80 U.S. patents and in some cases corresponding foreign patents. Securing the intellectual property rights for developed technologies is essential to achieve subsequent successful commercialization of those technologies. Another measure of success that is monitored is the total number of employees in the company at the end of each year. From two employees at the beginning of 1990, new hires have been added each year that the company has been in business giving a total of 149 employees at the end of 2003. Of these 109 were full time employees and 40 were part time as well as being undergraduate students at Texas A&M University. As a result of the SBIR and STTR programs, Lynntech is the leading high technology development and commercialization company in the Bryan/College Station region. The economic impact of the company in the region, which has surprisingly few similar high technology small businesses in view of the presence of Texas A&M University, is quite significant. To further illustrate the opportunities offered and the benefits received by participating in the SBIR and STTR programs, I will provide two examples of technologies developed and successfully commercialized at Lynntech under the SBIR program.

FUEL CELL TEST SYSTEMS

Fuel cells generate electricity through a chemical reaction between oxygen in the air and a fuel, such as hydrogen or methanol. As a result, they are quite efficient and clean; discharging only benign byproducts such as water vapor. These devices have the potential to power everything from laptop computers to manufacturing plants. Thus, for over the past 15 years extensive development of various fuel cell technologies for a variety of applications has been carried out by universities, national laboratories, and large as well as small companies both here in the United States and abroad. Developers of the various fuel cell technologies require advanced, fully automated, computer-controlled test equipment to determine the performance of fuel cell components such as electrocatalysts, as well as fuel cell stacks and fuel cell power systems.

State-of-the-art fuel cell test equipment was invented by Lynntech in the early to mid-1990s with funding for the design, fabrication, and testing stemming from a Phase II SBIR contract with NASA's Glenn Research Center. To match the requirements of individual fuel cell developers, Lynntech developed a modular approach on designing the test equipment (see Attachment I), enabling custom solutions with standard equipment. Since 2001, Lynntech Industries, Ltd., a spin off from Lynntech, Inc., has been manufacturing and selling a complete range of fuel cell test systems world-wide to meet the needs of customers in the rapidly growing market of fuel cells. Commercial sales of fuel cell test equipment were almost $ 2 million in 2003. Part of an experienced management team was put in place in Lynntech Industries in 2003 which is now actively pursuing venture capital to aggressively exploit this very significant business opportunity. This "success story" was written up in the NASA Spinoff 2003 Booklet (see Attachment II).

ELECTROCHEMICAL OZONE GENERATION TECHNOLOGY

Ozone has a long history associated with the treatment of drinking water at municipal water treatment plants. More recently, it has been used as the final treatment step in the preparation of potable bottled water. Ozone is known to be a potent disinfectant and is very effective for destroying a broad range of harmful microbiological species that may be present in water, food ingredients, and on surfaces such as flexible medical endoscopes. Ozone generation devices that have been used for decades include ultraviolet lamps and corona discharge generators, both of which require a source of oxygen gas to produce ozone. However, these methods of ozone generation suffer from a number of drawbacks including performance, reliability, durability, scalability, and cost.

In the early to mid-1990s with SBIR funding from NASA, Department of Health and Human Services, and the Department of Defense, Lynntech developed a new electrochemical method for the production of ozone from water and investigated the suitability of using it in a variety of applications. The electrochemical method provided many distinct advantages which are not available from the earlier mentioned ozone generation technologies. After securing the intellectual property associated with the electrochemical ozone generation technology, Lynntech initiated commercialization activities in the late 1990s. This resulted in the establishment of a strategic relationship between WaterPik Technologies, Inc., and Lynntech in 1999. A joint product development effort was undertaken by both companies to enable the use of the

technology in consumer home products. This lead to the completion of an exclusive license agreement between the companies in early 2000 and the successful launch of the first consumer product namely the Aquia™ for residue-free sanitization in the home in late 2001. WaterPik's Aquia™ product is shown and described in Attachment III.

The Aquia™ sanitizing system is a revolutionary household appliance introduced by WaterPik Technologies, Inc., that creates an all-natural, non-toxic sanitizing solution that is safe to use on food and surfaces to kill harmful germs. Aquia™ has been proven effective for use as a food contact surface sanitizer, non-food contact surface sanitizer and as an antibacterial rinse for fruits and vegetables. Aquia™ also significantly reduces the risk of bacterial cross-contamination during food preparation involving raw meats and poultry. Aquia™, which represents a new category in household products, creates activated oxygen, also referred to as ozone, by converting ordinary tap water into "ozone-infused" water through a patented electrochemical process. For years, ozone has been used commercially with the processing of produce and meats and in water purification but the necessary equipment was not economical for household use until Aquia™ was developed. The ozone-infused water produced by Aquia™ is more powerful than chlorine and can effectively kill 99.9 % of common bacteria including E. coli, Salmonella, Staph, Listeria and K. Pneumonia.

CONCLUSIONS AND RECOMMENDATIONS

In addition to the two technologies described above, Lynntech is in the process of commercializing a number of other technologies developed with SBIR funding. SBIR funding has been vital and essential to the growth and success of Lynntech over the past decade. Technologies in the embryonic stage of development at present will fuel future growth on being successfully commercialized either through spin offs, joint ventures, or licensing arrangements. Most of Lynntech's SBIR funded projects have been successful from a technical perspective and it is anticipated that many of them will also be successful economically.

Over the past ten years, Lynntech has worked with numerous technical and administrative personnel from various Federal Government Departments and Agencies. With very few exceptions, I would rate the level of technical and administrative support that Lynntech received, on numerous SBIR awards, as very good. In particular, the degree of interaction and contributions made by Contracting Officers Technical Representatives from the mission directed Agencies (e.g., DOD Agencies and NASA) were very good and extremely beneficial. I have not encountered any conflicts between the research goals of Federal Agencies that made SBIR awards to Lynntech and the business plan of the company. However, it must be pointed out that specific pieces of hardware delivered to a Government Agency for their use may not be relevant as a commercial product. It is the underlying technology, processes, and know-how accumulated during the SBIR project that can be used for the creation of useful commercial products.

To further improve the SBIR and STTR programs, it is recommended that:

- There should be more extensive participation of Federal Agencies in SBIR Phase III activities;
- There should be more extensive coaching and business support for SBIR/STTR funded small businesses so as to increase the level of commercialization activities;

- There should be greater participation by State Agencies in providing resources to SBIR/STTR funded small businesses that are complimentary to the existing Federal SBIR/STTR programs;
- There should be expanded regional conferences and workshops that provide information about the SBIR/STTR programs and sources of assistance for existing and start-up small businesses that are either participating or would like to participate in the SBIR and STTR programs;
- It should be required that business schools of Federally funded colleges and universities should interact with SBIR and STTR funded small business.; and
- Courses on new ventures and entrepreneurship should be established at colleges and universities.

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WORK EXPERIENCE:

1990 – present	President and co-founder, Lynntech, Inc.
1987 – 1990	Assistant Director, Center for Electrochemical Systems & Hydrogen Research, Texas A&M University
1984 – 1987	Project Leader, The Standard Oil Company, Warrensville Research Center, Cleveland, Ohio
1980 – 1984	Research Associate/Senior Scientist, Department of Chemistry, Texas A&M University

EDUCATION:

1980	Ph.D. (Electrochemistry): University College Cork/National University of Ireland, Ireland
1977	M.Sc. (Electrochemistry): University College Cork/National University of Ireland, Ireland
1976	H.Dip.Ed.: University College Cork/National University of Ireland, Ireland
1975	B.Sc. (Chemistry): University College Cork/National University of Ireland, Ireland

PROFESSIONAL SOCIETY MEMBERSHIPS:

Electrochemical Society
International Society of Electrochemistry
American Electroplaters and Surface Finishers Society
International Association for Hydrogen Energy

PUBLICATIONS:

Books and Book Chapters:

1. *"Electrochemistry in Transition: From the 20th to the 21st Century,"* (with S. Srinivasan and B. E. Conway), Plenum Press, New York (1992).
2. "*The Electrochemical Splitting of Water."* In: "Modern Aspects of Electrochemistry," eds., J. O'M. Bockris, R. E. White and B. E. Conway, Plenum Press, New York (1983), Vol. 15, Ch. 1.
3. *"Spectroscopic Characterization of the Passive Film on Iron Before and After Exposure to Chloride Ion."* In: "Electrochemistry in Transition: From the 20th to the 21st Century," eds., O. J. Murphy, B. E. Conway and S. Srinivasan, Plenum Press, New York (1992).

Refereed Journal Articles:

Over 50 refereed journal articles in national and international journals and over 60 technical presentations at national and international technical conferences. In addition, invited speaker at numerous regional and national Small Business Innovation Research (SBIR) Conferences.

PATENTS:

Over 50 issued U.S. patents and corresponding foreign patents.